

PRELIMINARY RELEASE

THE WAR EMERGENCY RADIO SERVICE
Civilian Defense Stations

OCD Publication 3040



Criticism and suggestions for the improvement of this manual are welcome. Address all communications to the Control and Communications Section of the Office of Civilian Defense, Washington, D. C. before February 1, 1943.

UNITED STATES OFFICE OF CIVILIAN DEFENSE

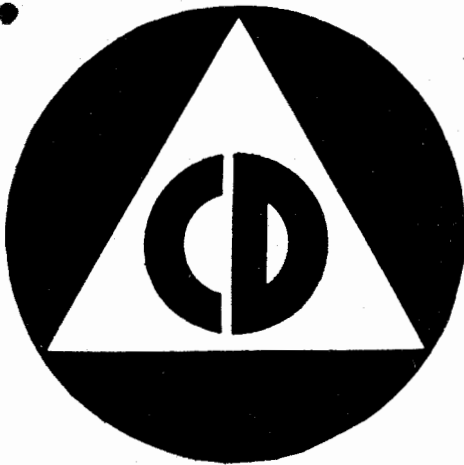
WASHINGTON, D. C.

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INTRODUCTION

Disasters which have fallen on this country in the past have demonstrated beyond all doubt the value of radio communication facilities, without which many communities would have been isolated and without means of calling for aid. Within a community stricken by flood or hurricane prompt rescue has been effected through the medium of radio facilities, established and operated in many cases by amateurs.

In recent years radio facilities have been used more and more extensively by many emergency services, such as police, fire, and public utilities.

The U. S. Office of Civilian Defense, being fully aware of the remarkable results achieved by the use of radio facilities in peace time, naturally desired to provide a means for supplementing the overloaded telephone systems, and which would help us in meeting other communications needs due to the emergencies caused by the war. To this end the problem was presented to the Federal Communications Commission and the Defense Communications Board (now known as the Board of War Communications), and on May 28, 1942, the War Emergency Radio Service was authorized, and radio channels were allocated for the joint use of Civilian Defense and State Guard Stations.

In providing these channels, considerable attention was given to a choice which would permit a type of service most useful to local communities under conditions which prevail during air raids and sabotage. The band of frequencies chosen permits adjacent communities to operate with a minimum of interference. The radio equipment needed for this service can be constructed from existing materials available from radio amateur sources. The regulatory requirements set up for the War Emergency Radio Service are not severe, and compliance is relatively simple.

This manual has been prepared by the U. S. Office of Civilian Defense as a guide for establishing the Civilian Defense Stations of the War Emergency Radio Service in networks most suitable for emergency communications, for organizing personnel to construct, install, and maintain the radio equipment, and for presenting all pertinent information to civilian defense councils, which will aid in organizing the Civilian Defense Stations on a uniform basis.

I. General

A. The Problem

If an organization is to function properly, some means of communication are necessary between the directing head and the operating units. In the case of civilian protection, the organization has already been developed, and many communities have established control centers in conformity with the general pattern outlined in the manual entitled "The Control System of the Citizens' Defense Corps," issued by the U. S. Office of Civilian Defense.

Control centers are the focal points at which air raid damage information is correlated. The up-to-the-minute picture of conditions throughout the control area which is available at this point is used to apportion the various services among various incidents as the need arises. The problems of outside reinforcement, of evacuation, and other kindred matters, are controlled from this point, in accordance with existing conditions.

As the control center is the brain of a civilian defense organization, the communications system may be considered the connecting nerves by which control is accomplished. The basic form of communications system used for civilian defense is the telephone, but this facility, due to its network of connecting wires, is quite vulnerable to bombing attacks. In England the problem of providing reliable communications under air raid conditions is met by supplementing the telephone system with a messenger system. In this country radio facilities are much more widely used, and it therefore becomes possible for us to utilize radio in practically every city to supplement telephone communications.

III. The Solution

The War Emergency Radio Service has been created specifically to meet the need for radio communications in connection with national security and civilian defense. This Service has certain advantages over other types of communications facilities. It is much less vulnerable to attack than any wired system; it is much more flexible and mobile, and it requires a minimum of critical materials. Furthermore, as a method of speedy dissemination of information, radio circuits have no equal. Messages from a control center can be directed by the proper choice of operating channels to all radio units in a city, or to individual groups representing various services.

II. Organization and Administration

A. Washington Office - U. S. Office of Civilian Defense

The U. S. Office of Civilian Defense was established by Executive Order of the President to assure effective coordination of federal relations between state and local governments with respect to adequate measures for protection of the civilian population. For administrative purposes, the U. S. Office of Civilian Defense is divided into several branches, among which is the Protection Branch. Under the Protection Branch, the Control and Communications Section is authorized to promote the establishment of the means of control and the communications facilities necessary to effect this control during emergencies. The promotion of all communications facilities and recommendations for their improvement are supervised by the National Communications Officer. Radio communications facilities are supervised by the National Radio Officer on the staff of the National Communications Officer.

B. Regional Offices - U. S. Office of Civilian Defense

Regional offices are located in each of the nine Service Commands (formerly known as Corps Areas). Although the territory covered by each OCD regional office is coincident with the Service Command area, the headquarters cities selected by the Army and those chosen by the Office of Civilian Defense are not always identical. A member of the regional staff is assigned the duties of communications officer for the region. He may devote his full time to these duties, or he may share his time between the duties of communications officer and other responsibilities.

It is the duty of the regional office to assist state and local defense organizations in developing civilian protection facilities in the component states.

C. State Defense Organizations

State defense organizations are usually established by state executive order or by state legislation and are empowered by such orders to coordinate and direct the civilian defense program of the state. Each state defense organization should have on its staff a State Communications Officer and a State Radio Officer, who will exercise general jurisdiction over all Civilian Defense Stations of the War Emergency Radio Service within the state.

D. District Warning Area - Warning District Control Center¹¹

Each state is generally sub-divided into district warning areas, which do not necessarily follow state boundaries, since such warning areas are based on telephone circuit facilities. A district warning center, established by military authority, is located in each warning area. It is located in the city where the toll lines connecting local exchanges for that area meet at a toll center. The district warning center receives information directly from Army Information Centers and disseminates this information (such as mobilization, blackout, etc.) under civilian authority to each local control center within the district warning area. The warning district control center may be either in the same office as the district warning center or at a separate location. In any case, this control center should have numbered among its personnel a District Communications Officer, and under him a District Radio Aide.

The OCD plan for WERS operation contemplates the establishment of a WERS network of Civilian Defense Stations interconnecting all communities within the district warning area. The district radio aide should obtain the mutual cooperation of all communities and set up a

-
1. The Warning District Control Center is the control center of the town or city in which the district warning center, established by the military authority, is located. Here, activities throughout the warning district should be coordinated. State Defense organizations may correlate all activities through these warning district control points.

network covering the whole district warning area. One license, issued to the community in which the warning district control center is located, covers all the towns within the warning district. In accordance with this plan, each town keeps its own radio equipment and has its own local radio technicians, but at the same time is so integrated with the larger group that, in the event of an emergency occurring in any particular town in the district warning area, the entire radio personnel from the area could be made available to the stricken city, according to the plan best suited to meet the immediate problem. When individual cities within a warning area obtain separate licenses, this is not always practicable. War Emergency Radio Service operator permits are valid only for the operation of stations licensed to the particular station licensee with which the operator is affiliated. In other words, if two adjacent towns hold individual WERS licenses, the operators from one town could not operate in the other town without another permit. This arrangement lacks the flexibility of the plan, where, under one license, either operators or equipment can be dispatched independently to any locations within the district warning area.

E. Local Control Center

The local control center provides facilities for coordinating air raid damage information from various incident areas by representatives of the emergency services. The personnel and operations of a typical control center are fully described in the OCD publication, "The Control System of the Citizens' Defense Corps," and in other related publications.

A communications officer and a radio aide should be on the staff at each local control center.

Chart A shows the organization extending from the U. S. Office of Civilian Defense to the local radio aides, while Chart B shows in detail the organization of the War Emergency Radio Service under a local radio aide.

F. State Radio Officer²

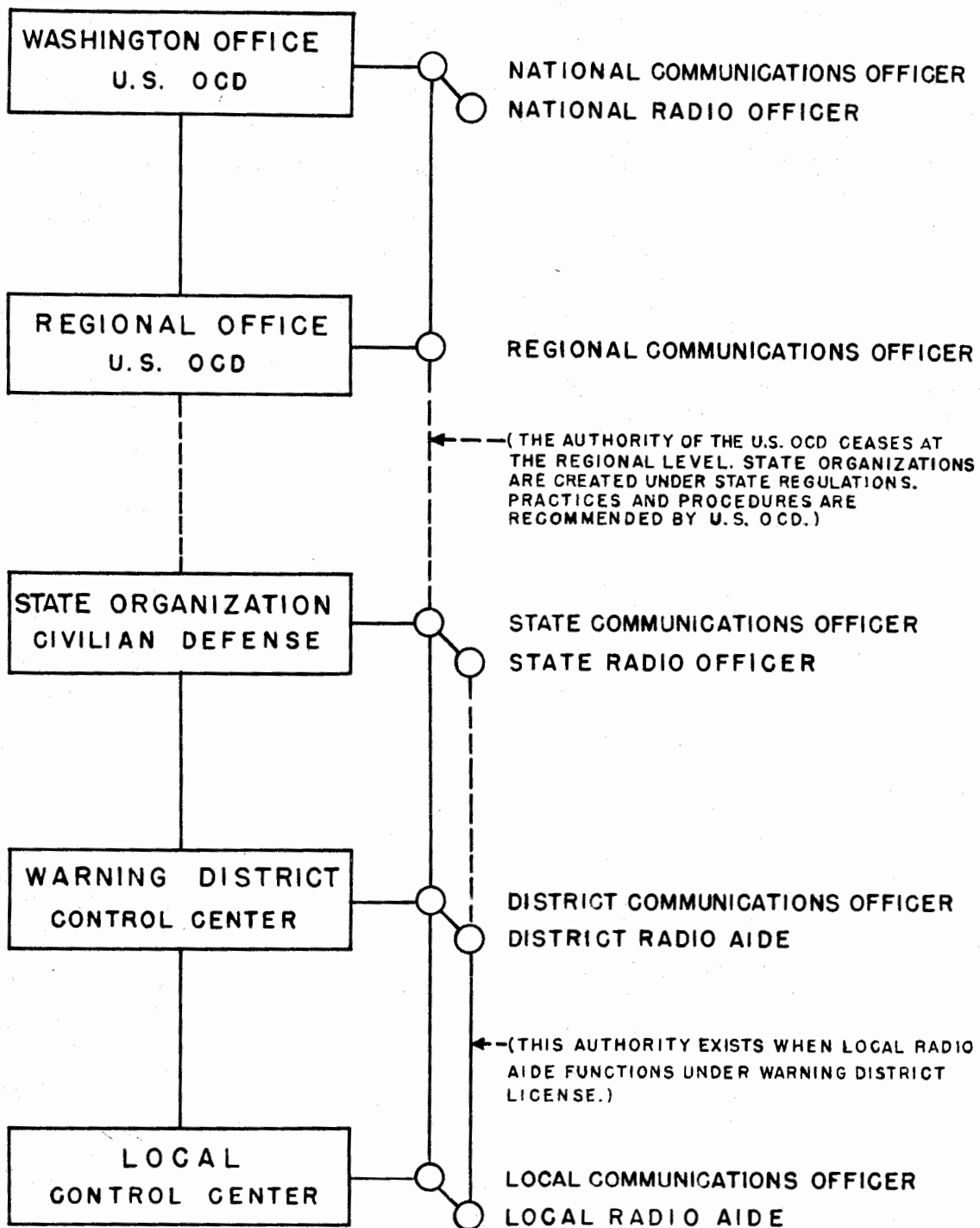
On the staff of the state communications officer there should be a state radio officer who has general supervision of the Civilian Defense Stations of the War Emergency Radio Service in the state. If the state radio officer finds it impractical to cover the entire state personally, he may appoint assistant radio officers, or he may make use of warning district radio aides for this purpose. It is not necessary for the state radio officer to be licensed by the Federal Communications Commission.

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2. This position is often designated as State Radio Aide. However, the term "State Radio Officer" is recommended in view of the fact that the term "Radio Aide" is used by the Federal Communications Commission to designate a person holding a particular type of license.

THE WAR EMERGENCY RADIO SERVICE CHART A

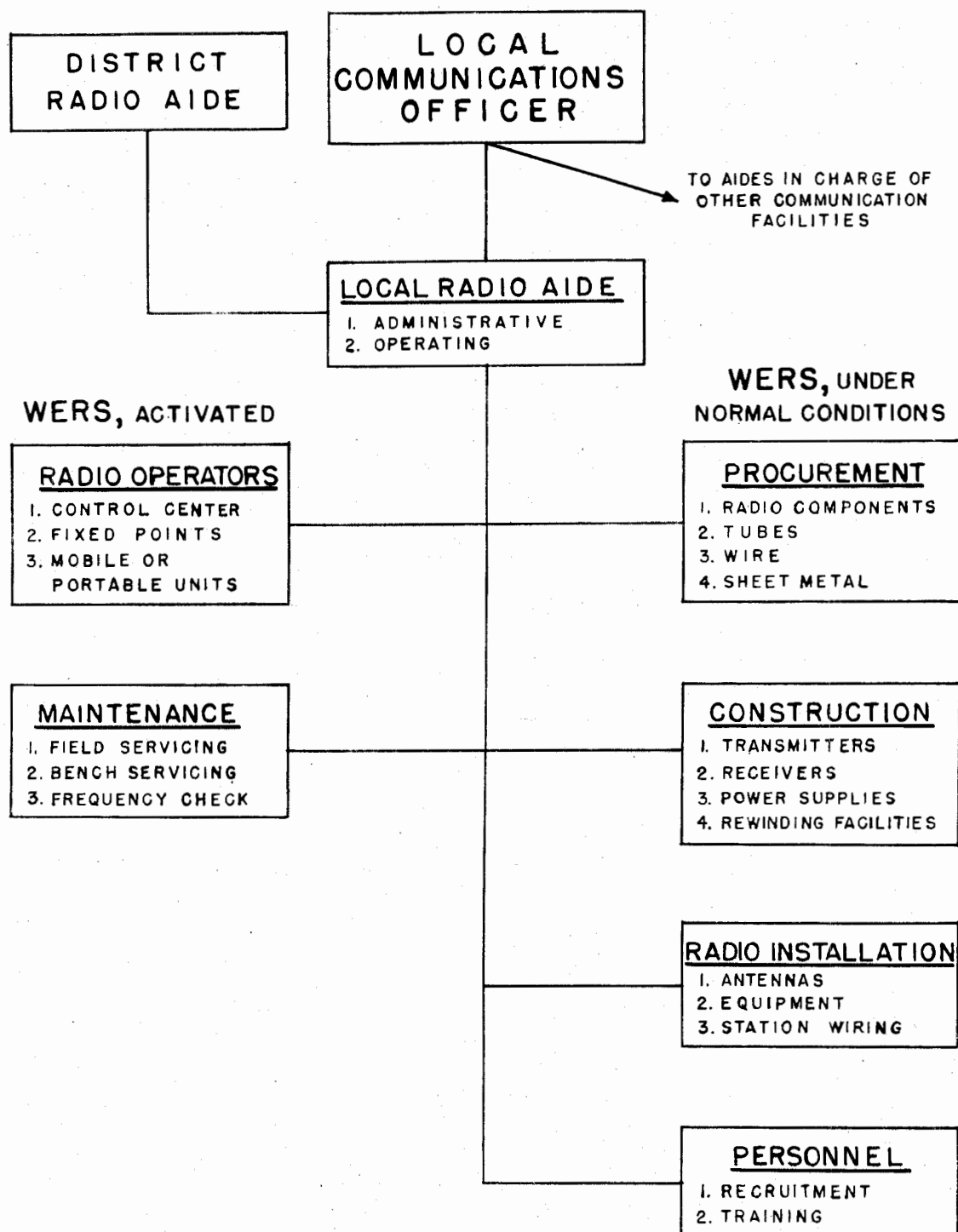
ORGANIZATION

PERSONNEL



NATIONAL AND STATE ORGANIZATION

THE WAR EMERGENCY RADIO SERVICE CHART B



LOCAL ORGANIZATION

G. District Radio Aides

When the Civilian Defense Stations of the War Emergency Radio Service are established on a district basis, in accordance with the plan recommended by the Office of Civilian Defense, a radio technician or ~~engineer~~ is certified on Form 455A³ when the application for the station license is submitted. On approval by the Federal Communications Commission at the time the station license is granted he becomes a radio aide and is responsible for the proper operation of all stations throughout the district covered by the license. It is the duty of this "District Radio Aide" to establish the War Emergency Radio Service throughout the district with the cooperation of the radio personnel on the staff of each local control center.

H. Local Radio Aides³

1. Under District Licensing Plan

When the Civilian Defense Stations of the War Emergency Radio Service are established on a district warning area basis, as recommended by the U. S. Office of Civilian Defense, one license is obtained in the name of the community in which the warning district control center is located. This license covers the stations of every community in the area. It is the duty of the certified district radio aide to establish and supervise the district network with the cooperation of the uncertified local radio aides. Local radio aides supervise the construction, installation, maintenance and operation of stations within the local communities under the direction of the District Radio Aide. Under this plan, the local radio aide, although he may retain the title, is not certified to the Federal Communications Commission as a radio aide; in this case he must be licensed as a radio operator if he desires to operate licensed transmitters.

2. Under Local Licensing Plan

In those cases where licenses have been granted to individual communities, the duties of the local radio aide are similar, but, since the stations under his supervision are not part of a district system, he exercises direct operational supervision and must be licensed as a radio aide to comply with the regulations. In the latter case full cooperation between the local radio aide and the district radio aide will be necessary if the community system is incorporated in the district plan. Unless this procedure is followed, the individually licensed community may find

3. See Appendix II. (15.71 to 15.74 incl.) The terms Local Radio Aide and District Radio Aide used in this manual are not always synonymous with the definitions of a radio aide contained in the Rules and Regulations of the Federal Communications Commission for the War Emergency Radio Service.

3. See Appendix II.

itself an isolated group with no outside communication facilities.

Alternates to district and local radio aides should be appointed who may assume the supervision of radio facilities in times when radio aides are absent.

I. Radio Operators³

This group, under the radio aide, operates the radio equipment when the WERS network is activated under emergency conditions and during test and drill periods. All radio operators must be licensed by the Federal Communications Commission. (See chart B)

J. Maintenance Group

This group maintains the equipment in perfect operating condition. Personnel in this group will function when the War Emergency Radio Service is activated, as well as under normal conditions.

K. Procurement Group

This group has the function of procuring the component parts to build radio equipment suitable for the War Emergency Radio Service.

L. Construction Group

The construction group builds the radio equipment from the component parts supplied by the procurement group.

M. Radio Installation Group

After the equipment has been built by the construction group, the installation group installs it at the designated points and in mobile units. The erection of antennas is also one of the duties of this group.

N. Personnel Training Group

This group has charge of the recruitment and training of operators, construction, maintenance, and installation men.

O. Summary

The apportioning of duties among the WERS personnel is done by the radio aide, and will be determined to a large extent by the personnel available. In the smaller communities, the radio aide usually performs the administrative and operational functions. In larger communities, he may appoint additional personnel for the purpose. The extent to which the various groups shown on Chart B are activated depends on the size of the community and on the contemplated expansion of the WERS radio facilities.

3. See Appendix II.

III. Personnel and Training

A. Personnel

1. State Radio Officer - (State Radio Aide)

Desirable qualifications for a state radio officer who may be appointed on the staff of the state communications officer include executive ability and operational experience in radio network operation. A member of a local broadcast station staff, or of a local commercial radio station, or a leading amateur who has been active in the Army, Navy, or American Radio Relay League communication networks on the amateur band, may have the proper qualifications. To avoid confusion, the title, "State Radio Officer," is recommended in place of "State Radio Aide."

2. Radio Aides, District and Local³

The radio aide has full charge of all radio units operating under the blanket license issued for the station with which he is associated. A capable radio technician with previous executive, operational, and constructional training should be appointed for this position by the licensee. When the WERS network is established on the district warning area basis as recommended by the U. S. Office of Civilian Defense, the radio aide at the warning district control center will have control of all stations within the district. On him will fall the responsibility of establishing the district and local networks. He must further provide for the training of radio operators and the training of construction, installation, and maintenance groups. In order to qualify for the position of radio aide with the Federal Communications Commission, he must hold a valid operator's license of a grade higher than a restricted radiotelephone operator's permit. When radio facilities are established on the above plan, the radio aide certified at the time the license is granted may be called a "District Radio Aide", since he has general supervision over all stations within a district under the one license. The local radio aides may still retain their title but they should be licensed as WERS operators, if they operate transmitters."

In those cases where licenses are requested by individual communities within a district warning area, the local radio aide for each community must be certified as such to the Federal Communications Commission, as stated previously. It should be noted that radio aides must also be certified as radio operators before they are permitted to operate Civilian Defense Stations of the War Emergency Radio Service.

3. See Appendix II.

3. Radio Operators.³

The personnel in this group are the actual operators of the radio equipment during the emergency. They must be chosen on the basis of their ability to carry on calmly and efficiently under the stress of any emergency. Obedience in carrying out orders, and rapid appraisal of a situation, together with ability to condense a complete picture into a few brief words, are essential.

Radio operators' permits for the War Emergency Radio Service are issued by the Federal Communications Commission only to those who already hold valid operators' licenses or permits of any grade. In order to be certified as a WERS operator, it is, therefore, necessary if the applicant holds no license that he first obtain at least a restricted radio-telephone operator's permit before he applies for a permit as a War Emergency Radio Service Operator.

4. Procurement Group

To this group falls the responsibility of providing the various materials necessary for the construction of the transmitters, receivers, power supplies, and antennas. Aid should be solicited from all likely sources, such as garage repairmen, sheet metal workers, and electrical service men. In fact, all the mechanical and electrical talent available should be enlisted in the procurement program. Many of these individuals may be willing and eager to qualify as radio operators, and this should be encouraged, since, during periods of emergency when the War Emergency Radio Service is activated, their services as operators will be needed.

5. Construction Personnel

This group should be recruited mainly from radio amateurs familiar with the construction of ultra high frequency radio equipment. Resourcefulness in using available materials for the construction of reliable and rugged transmitting and receiving equipment is essential. There is a place in this group, too, for the sheet metal worker and the cabinet maker in the construction of chassis and housings for the units. It is also expected that most of the personnel in this group will desire to qualify as radio operators.

6. Installation Personnel

This group should consist of electricians, radio amateurs, and servicemen most familiar with the electrical installation of control circuits and other wiring incidental to the permanent

3. See Appendix II.

installation of radio equipment. For the installation of antennas the services of public utilities or telephone construction men familiar with simple and reliable methods of erecting aerial installations can be enlisted. Auto servicemen should be helpful in making mobile installations in cars.

7. Maintenance Group

This group maintains the system in reliable operating condition at all times. It will function when the War Emergency Radio Service is activated during an emergency. The personnel should be chosen on the basis of ability to perform efficiently in the confusion accompanying air raids. This group may be made up largely of the personnel from the construction and installation groups. The group should in general qualify as radio operators to permit them to take over operating duties in the field whenever necessary.

8. Personnel and Training Group

This program may be handled by the radio aide himself, or he may appoint one or more assistants. The recruitment and training of the personnel of the various local groups comes under this heading. A radio amateur or technician in the personnel section of a local manufacturing company would be an ideal choice as a group organizer. For the establishment of training courses, the services of a teacher from the local high or vocational school, familiar with radio subjects, should be enlisted, if possible. In any case, these men should be chosen for their ability to organize and lead groups.

B. Training

1. General

State radio officers, district radio aides, and local radio aides, should be appointed on the basis of their previous training. Since a large portion of trained radio technicians is now in military service, training classes should be established to train operators and to train interested individuals in the construction, installation, and maintenance of equipment needed for the War Emergency Radio Service.

2. Radio Operators

Classes of one or two hours' duration two nights a week should be instituted. To be eligible for a WERS operator's permit an applicant must first obtain a restricted radio operator's permit, or any type of operator's license from the Federal Communications Commission. To obtain a restricted radiotelephone operator's permit, no knowledge of radio theory is needed. A knowledge of the laws governing the operation of radio stations and of the rules and regulations of the Federal Communications Commission applicable to the emergency services is required.

"A Study Guide and Reference Manual for Commercial Radio Operator's Examinations" is available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at fifteen cents a copy. A knowledge of Element 1 of this guide is required to pass the examination for the restricted radiotelephone operator's permit.

Examinations are given by radio inspectors at the places listed in Appendix III of this manual. These examinations also may be given by certified radio aides in their own communities, providing they are held in conformance with the rules of the Federal Communications Commission. Full information and application blanks can be obtained by radio aides from the radio inspector in the district in which they live.⁴

Two or three class periods should be sufficient to train the personnel for this examination. After restricted radiotelephone operators' permits are obtained, applications for WERS operators' permits should be filed with the Federal Communications Commission in accordance with the "Rules and Regulations Governing the War Emergency Radio Service," contained in Appendix II, attached to this manual. Classes should also be conducted in which operators are taught methods of briefing and coding messages to insure efficiency, speed and as much secrecy as possible.

3. Construction Classes, Installation Classes

Training classes for the less experienced personnel under the competent supervision of an experienced ultra high frequency technician are very desirable. In addition to providing experience in the assembling of equipment in accordance with good engineering practices, a considerable knowledge of radio circuits can be imparted. Equipment assembled in these classes can be installed for actual service.

4. Maintenance Classes

Similar classes can be established to train maintenance personnel. Here, thorough familiarity with the various pieces of equipment should be taught. In the training of maintenance personnel, emphasis should be placed on the servicing of actual radio equipment both in the field and on the bench. Defective parts should be placed in the equipment and programs should be arranged to provide training in locating and correcting these faults. This type of training will provide experience in correcting failures which occur in the field under actual emergencies.

5. Field Tests

Field tests should be instituted during periods allocated by the Federal Communications Commission, as listed in Appendix II, attached to this manual. This time should be employed for testing

4. Appendix III.

the proper functioning of the equipment after installation. During this time minor changes in antenna adjustments, etc., may be made to obtain maximum reliability in the various circuits. Other tests should be made to determine areas of poor reception. These areas should be charted, together with other areas in which best results are obtained. This information should be available at the control center.

6. Drills

Drills simulating the actual communications required under emergency conditions may be conducted to train operators and maintenance crews at any time during practice alerts, practice blackouts, or other comparable situations which may be initiated either by proper military authorities or by local civilian defense authorities. A licensee making use of such time for drill purposes, however, must send a notice of such operation by mail to the Federal Communications Commission's Inspector in the radio district in which the station is located⁴, and submit a copy to the Federal Communications Commission in Washington, D. C., within twenty-four hours after the drill.

IV. Equipment

A. General

It is not the purpose of this section to describe in detail the construction of ultra high frequency radio equipment. The many excellent articles appearing in current radio periodicals can be followed with confidence. Here, suggestions only will be offered based on general experience. From time to time the Office of Civilian Defense will issue supplementary information which it verifies and deems pertinent to the problems of the War Emergency Radio Service.

Although it appears impossible to standardize construction and types of equipment throughout the country under present conditions, adherence to a basic plan is highly desirable. This will facilitate coordination of equipment from several locations in the event of a major emergency in one area. Furthermore, too much emphasis cannot be put on neat, permanent, and enclosed construction in the interest of reliability. Haphazard, experimental types should not be tolerate

B. Power Supplies

1. Fixed Station Primary Sources

The primary source of power at all fixed points is the local public utility distribution system, generally 110 volts A.C. At the outset, and to expedite installations, this should be used.

4. Appendix III.

2. Fixed Station Secondary Sources

Because of the likelihood of power failure, a secondary source of power should be provided at the earliest possible date. One group of technicians should be assigned this problem. Secondary sources are:

a. Storage Batteries

These can be used both for filaments and for plate supply in connection with vibrator rectifiers. The batteries should be kept fully charged at all times. Automobile vibrator supplies may be used and can be operated in parallel if needed to provide additional current. Many radio technicians also have dynamotors which can be pressed into service.

b. Gasoline Motor Generating Units

Small units of this type have been in use in outlying areas, and, in many instances where public utilities have been extended, are no longer used. Five hundred watt units are common and many of the later types supply 110 volts A.C. Older types supply 32 volts D.C. Whatever the type, it can be adapted to provide emergency service. A further possibility would be to couple a small gasoline motor of the type used on washing machines and refrigerators through a Vee belt drive to an automobile generator. This generator, together with a storage battery which may be unfit for other service, provides a very reliable 6 volt supply. Gasoline driven generators will also provide current for lighting purposes at the control center in event of power failure. Automobile generators can be rewound and will supply upwards of 200 watts at 110 volts A.C., provided a second generator or a storage battery is used to excite the field windings. As can be seen from the above, there are activities for almost every technician with electrical knowledge in the War Emergency Radio Service.

3. Power Supplies for Fixed Station Equipment

Sources of transformers for filament and plate supply are discarded broadcast sets, amateur transmitters, and stocks of supply houses. Since transmitters are limited to 25 watts final amplifier input, a 300 volt plate supply will usually be adequate. Many broadcast receivers, especially in the older models, will provide transformers to serve this purpose. Some thought should be given the construction of transformerless power supplies using voltage doubling, tripling, and quadrupling schemes to obtain the required voltage. Choke coils,

condensers, and resistors of the types needed are also often found in the older types of broadcast receivers. If metal is not available for chassis, pressed board or asbestos shingles can be substituted. The asbestos shingles have the advantage of being fireproof. Whenever possible, use readily available tubes. For example, type 80's in parallel will serve in the place of larger types of rectifiers which are less common.

4. Mobile Power Supplies

a. Vibrator-Rectifier Power Packs

This type of equipment is commonly used in the ordinary type of automobile radio receivers. Current is drawn from the storage battery to operate an interrupting device called a vibrator, which changes the 6 volts D. C. into interrupted D. C., which is transformed into a high voltage by a suitable transformer. The current is then rectified and filtered according to standard practice. Receiver type vibrator-rectifier units can be used only for relatively low-powered transmitters. The output of two or more such units can be paralleled to obtain additional current. Provision must be made to step up the charging rate of the automobile generator in order to keep the storage battery fully charged at all times.

b. Battery Supply

For portable units the usual source of power supply is the common dry cell type battery. Light weight batteries have been developed for portable transmitting and receiving equipment.

C. Transmitters

1. Fixed Station Units

Except in those cases where equipment has been previously constructed, it is not expected that many crystal-controlled units will be available. Aside from these, the most stable and easily constructed units will be of the push-pull type using parallel rod tuning. Sufficient stability can be obtained in this manner to meet the regulations. The oscillator can be modulated directly, or still better, a master-oscillator-power-amplifier combination can be set up if tubes are available. The transmission line can be connected to the point of proper impedance on the plate rods through blocking condensers.

Modulation units for these transmitters will probably present the greatest problem due to shortages in materials. Since final input power is limited to 25 watts, 12.5 watts of audio power will be required for 100% modulation. A tube of the 6N7 type, driven by one of the 6J5 type with the use of a carbon microphone, probably will be most popular. This scheme will, however, require transformers of suitable types. It is suggested that there be chosen

from within the group of radio technicians one person with facilities and ability to rewind existing transformers for class B service and other uses.

Class A modulation can be resorted to if necessary, although the power supply requirements will be much more severe.

2. Mobile Units

Here a distinction should be made between those units installed in vehicles and those of the pack type commonly known as "walkie-talkies." Those of the vehicle type can be powered from the car battery, while the pack type usually depends on dry cells for power. It is expected that most of these latter types will employ coil and condenser type resonant circuits because of space limitation, although parallel rod types should be practical in many vehicle installations.

Since tubes especially designed for ultra high frequency use will be very difficult to obtain, it is suggested that the more common types of receiving tubes be employed. The number of different types of tubes used throughout the area should be held to a minimum to permit inter-changes when the need arises.

The most common and most available types of dry cells should be used for pack type units. Above all, construction should be rugged enough to withstand vibration and rough usage incident to portable and mobile use. It is suggested that all component parts, with the exception of the smaller type carbon resistors, be supported independently of their leads. Coils of a few turns of wire (No. 10 or larger) can safely be supported without forms if they are fitted into position free of strain.

Wood or asbestos board chassis can be used in lieu of metal, providing grounding strips are properly located. When metal is used, radio frequency circuits should be well spaced to insure high efficiency.

In most mobile units the grid circuit is usually an inductance, the plate circuit only being tuned. By properly proportioning the grid inductance, such a circuit will tune similarly to a crystal oscillator, displaying a definite dip in the plate current at the desired frequency. When the antenna (with its associated transmission line when used) is properly designed, the "loaded dip" should occur close to the unloaded point. Under these conditions maximum transfer of power to the antenna is attained.

D. Transceivers

Use of circuits of this type should be restricted so far as possible to low-powered pack units with dry battery operation. The impossibility of eliminating quench modulated radiation from the unit because of space requirements when it operates as a receiver suggests transceiver use only on low power. Highly modulated radiation of this type causes very serious interference to other units operating on the

same band, and it also extends to adjacent channels if units are in close proximity.

Since these units are necessarily of low power, the antenna system should be so coupled to the unit to provide maximum transfer of energy as a transmitter, even though this is not the best coupling for reception. It is assumed that the headquarters transmitter will be of high power which will overcome any slight inefficiency which results from such an arrangement.

E. Receivers

It is expected that superregenerative receivers will be used almost universally in the War Emergency Radio Service. The great advantage of simplicity and minimum tube and component part requirements will make it possible to provide the required number of receivers in most areas. It is felt that this advantage more than overrides the two main disadvantages, namely, radiation and broadness of tuning. Direct radiation can be reduced by complete shielding of the entire oscillating detector circuits and by inserting choke coils in the filament and plate leads to this unit with thorough by-passing inside the shield. Radiation from the antenna is more serious, and wherever possible a single neutralized radio frequency stage of amplification ahead of the detector is extremely desirable, even though it gives no additional gain. With this arrangement, and by careful design, almost complete elimination of receiver radiation can be accomplished. Receivers incorporating these suggestions are especially desirable for control center and other fixed point installations where the receiving antenna will be elevated and normally will have a greater radius of interference.

F. Antennas

At the control center every effort should be made to install the antenna at as great a height as possible. This is especially true for the channel to the warning district control center. When any choice exists, this channel should be given preference in respect to height, unless other local factors make it unnecessary. Next in importance is the antenna for the local mobile channel. Here, height is also of advantage, especially for reception, since better reception from low-powered field units will thereby be obtained. Communication with local fixed points should be relatively simple, since the antenna at both locations can be elevated.

Duplex operation is not contemplated, so the same antenna can be used for transmitting and receiving on any one channel, provided a suitable changeover switch or relay is used.

A complete control center installation consists of three antennas, one for each of the three services, with suitable transmission line connection. This system provides separate communication channels: (1) to the warning center; (2) to local fixed points; and (3) to local mobile units.

A center-fed half-wave vertical dipole antenna is suggested as the simplest and most efficient installation. The transmission line can be of the open wire type with two inch spacing. Any one of several matching methods can be used between the transmission line and the center of the antenna.

In vehicle installations a quarter-wave resonant antenna which employs the car body as counterpoise, and which is excited at its base, is suggested. Considerably greater range and freedom from directivity can be had if the antenna is mounted on the top of the car. It can be fed by means of a concentric transmission line made up of tubing, or braided shielding using beads for spacers.

In the pack units the antenna system should be coupled to the oscillator in such a manner that the antenna can be tuned to resonance on the desired frequency. Otherwise, maximum radiation of power is not achieved.

G. Miscellaneous Suggestions

It is desirable to standardize socket and plug connections between the various pieces of equipment so that inter-change of units can be made quickly. All wiring in the control center should be done neatly and permanently. Haphazard, loose wiring at a point where speed and efficiency are imperative should not be tolerated in War Emergency Radio Service installations. The Controller should be consulted prior to the establishment of radio facilities. Information should be obtained from him regarding the extent of the service which is required. The location and space needed for the equipment at the control center should also be approved by the Controller.

V. Operations

A. Licensing Procedure

The information contained in this Section is supplemental to the Rules and Regulations of the Federal Communications Commission in Appendix II. Close adherence to these suggestions and to the Rules and Regulations will assure prompt action by the Federal Communications Commission and avoid the necessity of resubmission.

A municipality desiring the use of the War Emergency Radio Service facilities should communicate with the appropriate field office⁴ of the Federal Communications Commission, requesting a copy of the "Rules and Regulations Governing the War Emergency Radio Service" (Part 15)³; an application blank for War Emergency Radio Service, Form 455; an application blank, Form 455A, "Certification

3. See Appendix II

4. See Appendix III

of Radio Aide"; and a sufficient number of application blanks for operators' permits, Form 457, to accommodate the number of operators required by the community.

In submitting the application blanks, Form 455 must be accompanied by Form 455A. Applications for operators, Form 457, may be submitted at a subsequent date, and applications for additional operators' permits may be submitted from time to time as new personnel is trained.

1. Eligibility of Applicants

Authorizations for civilian defense stations will be issued only to municipal governments, such as cities, towns, counties, townships, boroughs, etc. Organizations such as police departments, civilian defense councils, and citizens' defense corps are not eligible. The application itself should be filed by the chief executive of the municipality, i.e., the Mayor, the City Manager, the First Selectman, the Chairman of the Board of County Commissioners, etc. No other person is empowered to sign the application, unless he has been expressly authorized to do so in writing by the chief executive of the municipality, in which case a copy of the authorization should be submitted with the application.

2. Supplementary Statements

In connection with the supplementary statements required by Section 15.62 of the Rules and Regulations, the applicant should submit complete information on each of the points enumerated in the Section. There has been a tendency on the part of applicants to make their supplementary statements too sketchy and to fail to answer some of the questions asked.

Under the recently revised regulations, each applicant is requested to show a method of compliance with Restricted Order No. 2. This order requires that the applicant must provide for the reception of silencing orders by wire from a point having a direct connection with the U.S. Army Information Center, or must maintain a listening watch on a key broadcast station. The first method is employed in most cases. Information as to whether the second method may be used should be obtained from the Controlling Authority at the Information Center for the region in which the applicant's station is located. Exact locations and street addresses of Information Centers are confidential. Mail should be addressed to Army Air Forces' Information Center, followed by the name of the city. Street addresses are not to be used in addressing mail to this point.

3. Maps

Maps submitted with the applications must conform to each of the requirements indicated in Item 9(a) on the FCC Form 455. Maps should indicate the usual area of proposed operation of portable and portable-mobile units.

4. Jurats, Affirmations, and Notarizations

All jurats and affirmations contained in the application and the "Certification of Radio Aide" must be completed.

Any amendment to the application subsequently submitted to the Federal Communications Commission must also be subscribed, verified, and submitted in the same manner and with the same number of copies as was the original application.

5. Technical Data

Under Item 6(g) of FCC Form 455 the applicant must indicate the frequency band over which the transmitter may be tuned by specifying approximately the highest and lowest frequencies in kilocycles. The applicant must indicate in Item 8 (a) the street, the number, the city, and the state, as well as the maximum height of the antenna above the ground, for each unit proposed to be operated at a fixed location.

The applicant should describe completely in Item 8(b) any conditions which, in his opinion, may obviate the necessity for painting and lighting antenna structures.

6. Radio Aide

aide

The radio/should sign the FCC Form 455 at the bottom of page 5. He should also sign his acceptance of appointment on Form 455A, page 2. The reference made to communications officer in the certification applies only to state guard applications and not to civilian defense stations.

7. Operators' Permits

To be eligible for a WERS operator's permit, an applicant must hold a radio operator's license or permit of any class and must have complied with the provisions of FCC Order No. 75 regarding the supplying of fingerprints and proof of citizenship.

All applications for WERS operators' permits must be submitted through station licensees. Applications for such permits submitted by individuals and not through station licensees will be returned by the Federal Communications Commission without action.

Applications for WERS operators' permits should not be submitted to the Federal Communications Commission prior to the station application, Form 455, since the operators' permits will not be granted until such time as the related station license has been granted. Item 17 on Form 457 must be signed by the radio aide.

A radio aide, even though properly certified on Form 455A, is not authorized to operate a civilian defense station unless he also holds a WERS operator's permit.

WERS operators' permits are valid only for the operation of stations licensed to the particular licensee with which the

operator is affiliated. In other words, a WERS operator's license does not entitle the holder to go to an adjacent town and operate civilian defense stations under the call letters of the adjacent town without an additional permit."

B. Procurement of Equipment

In view of the shortage of critical materials, it is not expected at this time that much new equipment, or many new components can be purchased. It is anticipated that local amateurs will make their radio equipment available to municipalities either by outright sale or on a lend-lease basis for the duration. Any community finding it impossible to purchase radio equipment for the War Emergency Radio Service, and finding it impossible to obtain such equipment from local amateurs, should communicate with the appropriate OCD regional office for assistance in locating component parts or equipment which may be available in other communities. The suggestions found in Section IV of this manual regarding the building of WERS equipment from readily obtainable parts should be thoroughly studied.

C. Basic Communications Plan

The control center in each community is the point at which all activities are correlated. Here a complete, up-to-the-minute picture of conditions must be kept, in order that proper dispatch and cooperation of the various crews in different incident areas may be effected. Without rapid and adequate communication facilities, this would be impossible. A basic plan of radio communications, called the "Tri-Part" plan is illustrated on Chart C. Its use is strongly recommended by the U.S. Office of Civilian Defense. This plan divides communications between the local control center and other points into three categories. Its use will assure maximum message handling ability and great flexibility of control.

1. LD Band (Local-District)

This radio link constitutes the emergency communication service between the local control center and the warning district control center. One of the channels in this band is called the local-district channel (abbreviated LD). It is the civilian communications link from a community to the next higher level of authority. It provides a channel through which coordination of all services throughout a district can be attained, and through which aid may be summoned from other areas.

a. Choice of Channel⁵.

It is suggested that this service be established in the 112-114 m.c. region, where the tolerance is .1 of 1%. Since the equipment at both ends is permanently installed, it can be

5. See Chart D

held within this deviation. In general, local conditions determine whether or not all channels from the local control centers in a district to the warning district control center operate on the same frequency. The warning district control center is the control center located in the same city with the district warning center. Since a separate fixed tuned receiver is required for each channel at the warning district control center, sharing of channels to this point by the local control centers is recommended. When more than one channel is used, they should be staggered so that adjacent communities operate on different channels. This provides separate channels for communication to the warning district control center from adjacent communities likely to be affected simultaneously by an air raid. Remote localities operating on these channels are less likely to require their use at this time. It may be that in some areas it will be impossible to establish this channel in one jump. Under this condition a relay point should be set up at an intermediate point permanently, and, if possible, at a high elevation. A radio operator should be assigned to this station with instructions to report there without fail whenever a warning is received. The transmitter at this relay point may be operated on the same frequency as that chosen for the local control center.

Efficient operation requires strong signals, and to a great degree strong signals are the result of high elevation for antennas. If control centers are not situated on high terrain, advantage should be taken of nearby elevated structures whenever possible.

2. LF Band (Local-Fixed)

Here again one or more channels may be chosen in the high stability section of the assigned frequencies. Whether separate channels for different services will be required depends largely on the size of the community. To some points, such as fire, police, medical centers, certain wardens' posts, etc., two-way circuits may be required; to others, one-way "out" order channels may be sufficient. (See Section 15.64 of Appendix II).

One transmitter at the control center may be used for this service. Where more than one channel is deemed necessary, frequency change should be rapid and dial settings controlled in definite notches. Channels in adjacent portions of the band should be chosen so that the radiating antennas will be equally efficient on all frequencies. Fixed and locked tuning of units, especially at remote points where less experienced personnel will operate, is recommended.

a. Metropolitan Arrangement of Channels

In large metropolitan areas the local control center as described throughout this manual may be one of several sub-local control centers which report to a main local control center

where information from all city areas is coordinated. In this case, channels should be established from each of the sub-local control centers to the fixed services within its area in the same manner as described for a community with one local control center. If individual receivers are installed at the main control center, tuned to each of the LF and IM channels in use, information regarding the dispatch of all units throughout all sub-control areas is received coincident with its transmission. One or more transmitters at the main control center, which are provided with means of transmitting on any of the channels used in the sub-control centers, will serve to link the main center with each sub-control center and with each of the headquarters of the various services within its range.

3. IM Band (Local-Mobile)

These facilities should in general be established in the 114-116 m.c. region, where less stability is required. Separate channels may be employed on this band as in the LF band, if necessary. Mobile equipment will be of the transceiver type to a great extent and, therefore, of low power. For this reason, the erection of an efficient receiving antenna for this channel at the local control center is essential.

a. Inter-Mobile Communication

If groups of transceivers assigned to particular services, such as rescue, medical, or first aid squads, operate on different channels in the IM band, intercommunication between the personnel of any one group within the field of damage is possible. These transmissions will in general be received at the local control center and at the particular service headquarters, as well. Separate IM channels, the number depending on local needs, when established, provide greater traffic handling capacity.

4. Summary

The radio equipment in a well organized control center consists of three transmitters and three (or more) receivers, all of the fixed tuned type, with the possible exception of the mobile station receiver at the control center. The transmitters and the receivers need not be on the operating desk, but "send-receive" controls for all should be located there, if this is not the case. Where transmitters operate on more than one channel, it will be well to remember that speed is essential in times of emergency, and provision should be made for rapid and definite change-over, especially when the transmitters are remotely located.

Arrangements should be made with the local communications officer for suitable space for radio equipment in the message room. Where

equipment is not immediately available to establish the complete radio communications network as outlined, provision should be made for subsequent additions, particularly as regards operating table space and antenna locations. The additional equipment can be added later as it becomes available.

D. Operating Procedures

As explained in Section I on Organization, the Office of Civilian Defense recommends that applications should be filed in the name of a municipality in which a district control center is located (the Federal Communications Commission has defined municipality as meaning a city, town, or county). Such a municipality in turn arranges to provide requisite emergency radio service to the entire district warning area. Under this plan only one license is issued to cover the entire area, and each local control center has a local radio aide who in reality acts as an assistant to the licensed radio aide at the warning district control center. This arrangement provides the greatest flexibility in the use of the War Emergency Radio Service, since operators and equipment can be sent to any stricken community within the area when the need arises. Under ordinary conditions each community would operate with its own personnel and equipment exactly as it would if each community received its own individual license.

Chart C shows a district warning area in which there are several local communities. The network of fixed and mobile units² of some of the services operating on recommended channels is shown.

1. Warning District Control Center - Local Control Center Message Traffic - (LD Traffic)

Message traffic from the warning district control center to the local control center should be controlled by the radio aide at the warning district control center. His duties will be to control and relay traffic between the different local control centers.

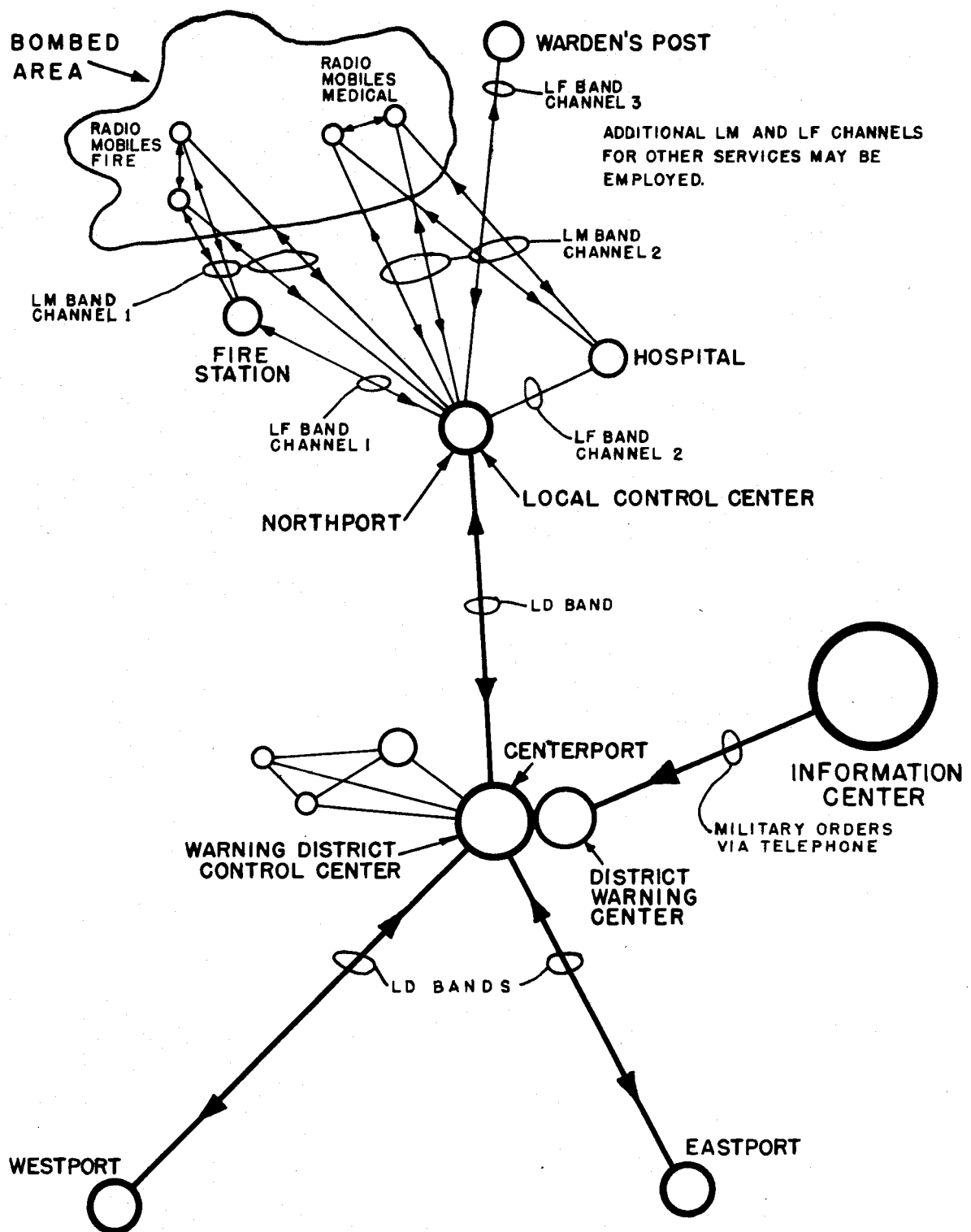
The local control center radio aide calls, waits for a "go ahead" from the district control center radio aide or one of his operators and then proceeds with the message. A similar process functions in the reverse direction.

2. Local Control Center - Fixed Point Communications

The same procedure is adopted for point-to-point communication from the local control center to the various emergency services within its area.

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5. Mobile units, or radio mobiles are radio units which may be installed in vehicles or carried by hand and which may be operated when in motion or when stationary.

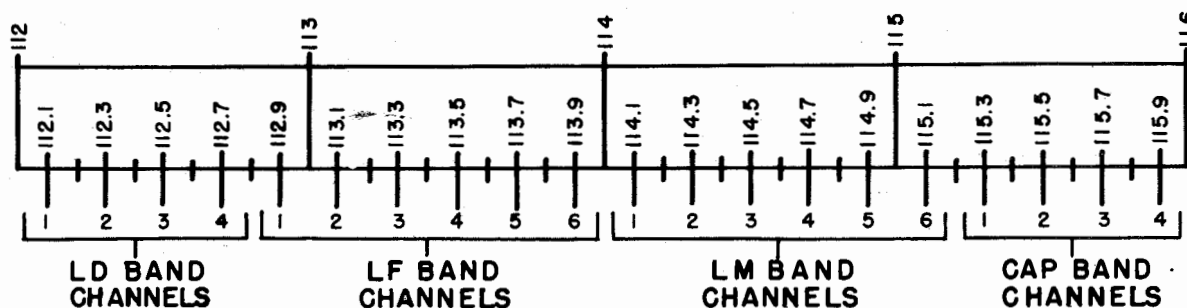
THE WAR EMERGENCY RADIO SERVICE CHART C



THE TRI-PART PLAN
FOR A
DISTRICT WARNING AREA

THE WAR EMERGENCY RADIO SERVICE CHART D

112-116 MEGACYCLE BAND ALLOCATION OF CHANNELS IN ACCORDANCE WITH RECOMMENDED PLAN



LD BAND

CHANNELS IN THIS BAND ARE USED FOR COMMUNICATION BETWEEN CONTROL CENTER AND WARNING DISTRICT CONTROL CENTER. THIS IS THE SUPPLEMENTAL CIRCUIT BETWEEN A COMMUNITY AND AN OUTSIDE POINT.

LF BAND

CHANNELS IN THIS BAND ARE USED FOR COMMUNICATION BETWEEN CONTROL CENTER AND LOCAL FIXED POINTS SUCH AS HOSPITALS, FIRE STATIONS, WARDENS' POSTS, ETC. THE CONTROL CENTER CO-ORDINATES THE ACTIVITIES OF THE VARIOUS SERVICES OVER THESE CHANNELS IN THE EVENT OF FAILURE OF TELEPHONE SERVICE.

LM BAND

CHANNELS IN THIS BAND ARE USED FOR COMMUNICATION BETWEEN CONTROL CENTER AND MOBILE UNITS OF THE VARIOUS SERVICES AT THE SCENE OF THE INCIDENT. AN "UP TO THE SECOND" PICTURE OF THE PROGRESS OF THE INCIDENT IS MAINTAINED AT THE CONTROL CENTER FROM INFORMATION RECEIVED OVER THESE CHANNELS. THIS ENABLES THE RAPID CO-ORDINATION OF ALL ACTIVITIES AND PROMPT DISPATCH OF AID THRU THE USE OF ANY BAND FOR OUTGOING ORDERS FROM THE CONTROL CENTER.

CAP BAND

BY AGREEMENT BETWEEN THE UNITED STATES CITIZENS' DEFENSE CORPS AND THE CIVIL AIR PATROL, THESE FOUR CHANNELS HAVE BEEN SET ASIDE FOR THE USE OF CAP TO ELIMINATE SERIOUS INTERFERENCE WHICH MIGHT OTHERWISE OCCUR BETWEEN AIR AND GROUND STATIONS.

TRI-PART PLAN CHANNELS

In large metropolitan areas, sub-divided as explained in Section C-2-a of Chapter V on "Operations", it is the usual custom to send damage and dispatching reports to the main local control Center at regularly scheduled intervals during an emergency. The use of radio facilities provides a means for reception of the orders at the time they are communicated to the sub-control center. The main control center is thus provided with "up-to-the-second" information and does not have to wait for the periodic telephone report to correlate its plans. Moreover, the heavy burden of the telephone service, bound to exist at such a time, will be lessened.

3. Local Control Center - Mobile Message Traffic

Here again a similar operating procedure should be established. An exception to the use of fixed tuned receivers at the local control center may be of advantage on this channel in receiving mobile units, especially of the low power, transceiver type. The possibility of draft and frequency change due to rough handling suggests a vernier dial on the receiver used to pick up mobile transmissions at the local control center. In this case the receiver should be installed on the operating desk. In those cases where more than one channel is used, the receiver at the local control center should have a notched channel changing arrangement with vernier tuning of each channel.

APPENDIX

- I. Glossary of Radio Terms
- II. War Emergency Radio Service Rules and Regulations of the Federal Communications Commission
- III. Addresses of Federal Communications Commission Field Offices

APPENDIX I

GLOSSARY

This glossary is attached to the manual in order to provide an explanation of some of the terms used throughout the text which may be of help to anyone not familiar with radio terminology. The glossary should be read in sequence since reference is made in subsequent paragraphs to material contained in earlier definitions.

1. Direct Current

A steady unvarying current obtained from a dry or storage battery, or from a "direct current generator." This type of current will flow in the circuit only when the entire path is of conducting material (wire).

2. Alternating Current

A varying current produced by an "alternating current generator." This current varies continually from its maximum value in one direction through zero to its maximum value in the other direction. This is the type of current generally delivered by the power companies for all lighting, power, and heating purposes. Sixty cycle alternating current as usually supplied varies in the above manner sixty times a second. This variation is rapid enough so that, when it is used for lighting, it does not cause a flicker.

3. Radio Frequency Current

This is an alternating current of very high frequency, in which the variations may occur hundreds of thousands, or even millions, of times a second. For instance, a radio broadcasting station operating, say, on 750 kilocycles supplies alternating current to its antenna at a frequency of 750,000 cycles (one kilocycle equals one thousand cycles). This type of current is usually produced by vacuum tubes with associated equipment called "vacuum tube oscillators." The War Emergency Radio Service operates on very high frequencies between 112 and 116 megacycles, or from one hundred and twelve million to one hundred and sixteen million cycles (one megacycle equals one million cycles). Frequencies above thirty million cycles are called ultra high frequencies and are largely used by radio stations in emergency services, such as police, forestry, etc. The radio transmission characteristics of space make these frequencies mainly useful for local communication.

4. Condenser, Blocking Condenser

A condenser in its simplest form consists of two sheets of conducting material (metal foil) separated by insulating material which may be air, glass, mica, etc. In practice several layers are interleaved and often encased in bakelite. A condenser has no conducting circuit and therefore will not pass direct current. However, when alternating current is applied to one series of plates, the opposite plates become electrified and current continues to flow. The higher the frequency, the less such a

device impedes the flow. In other words, the alternating current resistance, or the impedance, is less, the higher the frequency. A condenser may be used in a circuit to prevent direct current from flowing, while at the same time allowing alternating currents to pass. When used in this manner, a condenser is called a blocking condenser.

5. Choke Coil

A coil of wire, while not impeding the flow of direct current appreciably, does retard the flow of alternating current. When a varying current flows through such a coil, currents are induced in adjacent turns in the opposite direction which tend to stop the main flow. This effect, being due to magnetic action, is greatly increased when the coil is wound on an iron core. Such a device is used in the opposite manner to a condenser, in that it will allow direct current to pass, while greatly retarding the flow of alternating current. A coil of a few turns with an air core performs this function satisfactorily at high radio frequencies, but at the low sixty cycle lighting current frequencies large coils on iron cores must be used to retard the flow materially.

6. Resistance

All conducting materials offer some retarding action to the flow of current. This is due to the internal friction of the current carriers (electrons) in passing through the molecular structure of the material. Heat is generated in the process and represents a loss of power. In materials which are good conductors this loss is very small. Silver, copper, and aluminum are excellent conductors and have low resistance. Iron and certain alloys have very high resistance and are used to produce heat from electricity (electric stove units). In radio equipment resistances (resistors) are not generally used to produce heat, but are generally used to limit the flow of current. Resistors are made in various forms, depending on their use. Some are wire wound on insulating material and covered with baked enamel. Others are small rods of carbon compound, having leads attached to the ends. Resistors in general offer the same impeding action to direct and alternating current and cannot be used to separate the two, as in the case of the condenser or the choke coil.

7. Impedance

The impedance of a circuit composed of a condenser, a choke coil, or a resistor, or a combination of any of these elements, is the alternating current resistance, or the factor which represents their combined or individual retarding action. A condenser offers less retarding action and therefore has less impedance, the higher the frequency; a choke coil or inductance offers more retarding action and therefore has a higher impedance, the higher the frequency.

8. Power, Audio Power, Radio Frequency Power

When electrical current is used to operate any device, power is required, which is the same as in the mechanical case. The mechanical unit of power is the "horse power" and the electrical unit is the watt, which equals 1/746th part of a horse power. Thus, a 50 watt light bulb uses approximately 1/15th of a horse power. The radio frequency power supplied

to a radio antenna by vacuum tubes is also expressed in watts; similarly, the electrical power representing voice or music applied to a loudspeaker and produced by an amplifier is also given in watts and called the audio power.

9. Microphone

A microphone is a device used to transfer the variations in intensity and "pitch" (frequency) of voice or music into similar variations of electric current. Sound waves impinging on a diaphragm or other surface cause it to vibrate. In turn, these vibrations vary or generate electric current in the device attached to the diaphragm. In the simplest form, known as a carbon microphone, a capsule containing small particles of carbon rests against the diaphragm. The vibrations cause the carbon particles to become agitated and cause variations in a small electric current passing through the capsule, in accordance with the sound vibrations of the voice or music. The audio power produced may be only a few thousandths of a watt.

10. Vacuum Tube, Grid Circuit, Plate Circuit

The vacuum tube in a simple form used for amplification and oscillation consists of three main elements: a filament or cathode which produces the electrons, a grid through which the electrons pass, and a plate on which the electron stream is collected. The electron stream can be thought of as an electric current, and a grid acts as a trigger or valve in controlling this stream. Thus, a small amount of energy applied between the grid and cathode can control the main stream flowing from the cathode to the plate and cause it to vary with similar, but much greater, amplitude. The grid circuit, or input circuit, is the circuit which supplies the controlling power and comprises the equipment connected between the grid and cathode. The plate circuit, or output circuit, is the circuit into which the plate of the tube delivers the amplified power. This circuit provides a return path between the plate and the cathode.

11. Vacuum Tube Amplifier, Audio, Radio

Vacuum tubes, when associated with the proper circuits, have the ability to amplify currents of small magnitude, such as are produced by a microphone. The output of one tube and its associated circuits may be applied to a second, etc. Thus, the very small audio power from a microphone may be amplified to any desired amount, representing hundreds of watts of power identical in variation with that of the voice or music applied to the diaphragm. Audio frequency variations of voice and music have a range of from approximately thirty cycles (vibrations per second) to more than ten thousand cycles. Intelligible voice can be transmitted within a range of from two hundred to three thousand cycles. Similar amplifiers, with circuits adapted for the purpose, can be used to amplify radio frequency currents generated by a low-powered vacuum tube oscillator. After amplification, the power can be applied to a transmitting antenna which radiates radio waves into space.

12. Vacuum Tube Oscillator, Inductance

Inasmuch as the vacuum tube amplifies, several units of energy are available in the output (plate) circuit for each unit in the input (grid) circuit of the tube. If a small amount of this amplified output power is fed back into the input side, and the process repeated over and over at regular intervals a sustained alternating current is produced. The frequency of the energy produced and the automatic timing are determined by the associated circuits. The alternating current energy thus produced is extracted from the direct current tube supply. For the production of radio frequency power the circuits consist of a coil of wire (inductance) and a variable condenser connected to the output (plate) of the tube. The size of the inductance and of the condenser determines the frequency. A small coil of a few turns and an air condenser of a few small plates would be used in the production of the very high frequencies employed in the War Emergency Radio Service.

13. Crystal Oscillator

If a specially ground quartz crystal is employed in conjunction with a vacuum tube and an output circuit consisting of a coil and a condenser, it provides a very accurate means of controlling the frequency of the current produced. Quartz crystals are thin plates cut at a certain angle from a large natural crystal. They are ground very carefully to a definite thickness which is the factor controlling the frequency. They are usually mounted in small enclosed holders to protect them from dust and mechanical damage.

14. Radiation of a Radio Wave

The mechanism by which radio waves are radiated into space from an antenna does not admit of any simple explanation. However, it is necessary in order to accomplish this that the frequency, or rate of variation of the current, be extremely high; in broadcasting, the frequencies are between five hundred thousand and one million five hundred thousand cycles. In the War Emergency Radio Service they are much higher, being between one hundred and twelve million and one hundred and sixteen million cycles. The antenna which will efficiently radiate a wave is shorter, the higher the frequency, so that for the War Emergency Radio Service it need be only a few feet long and is therefore well adapted for portable use.

15. Modulation, Modulator, 100% Modulation

Audio power, amplified and representing the variations of voice or music, cannot be radiated directly, because the frequencies are much too low. A second transformation is therefore needed, in which the audio variations are made to alter the radio frequency current flowing into the antenna in accordance with the pitch and intensity of the voice or music. The process by which this transformation is most commonly accomplished is called amplitude modulation (AM). Radio frequency current is 100% amplitude modulated when the audio power from an amplifier is applied to the radio frequency circuit in such a manner that the radio frequency current is caused to vary between zero and twice its normal value. An

audio amplifier used for this purpose is called a modulator, or modulating amplifier. Another modulating process in which the radio frequency is varied instead of the amplitude is now in limited use and is known as frequency modulation (FM).

16. Modulation, Class A and Class B

Audio amplifiers, when used as modulators, fall into two classes, known as Class A and Class B amplifiers. In the Class A amplifier, the vacuum tubes and their associated circuits function in a manner which results in a very faithful and undistorted amplification of the voice or music. Class A type has relatively low efficiency. For Class B service, special tubes, to be used with special circuits, have been developed which provide much greater power amplification. The resultant high efficiency makes it possible to produce the required power with less tubes and equipment. This is done at the expense of a slight loss of fidelity.

17. Push-Pull Amplifiers and Oscillators

Two tubes are often used in a balanced arrangement to replace a single tube in one or more of the stages of an amplifier. The input energy is applied between the grids of the tubes and the output power is withdrawn from circuits connected to the plates. When this scheme is used for audio amplification, less distortion occurs. When it is employed at high radio frequencies as an amplifier or as an oscillator, higher efficiency can be obtained, because the characteristics of the tube are more favorably employed.

18. Master Oscillator-Power Amplifier

When radio frequency energy is produced at relatively low power by a vacuum tube oscillator and amplified by a radio frequency amplifier before it is fed to the antenna, the combination of oscillator and amplifier is known as a master oscillator-power amplifier combination. The term is generally applied when the oscillator is not crystal controlled, and the combination is used to provide a more stable and closer control of the frequency.

19. Neutralized Radio Frequency Stage

A radio frequency amplifier, especially when used to amplify very high frequencies, tends to oscillate because some of the energy is fed back into the input circuit through the tube itself. In order to prevent this, additional circuits are often added to feed back an equivalent amount of energy in the reverse direction and so neutralize any tendency to oscillate. The tube is thus made to function strictly as an amplifier.

20. Final Input Power

A vacuum tube cannot amplify or generate radio frequency without being supplied with power in another form. In the case of the generator, the power supplied must be equal to the radio frequency energy produced plus an extra amount representing the losses in the tube and in the

associated circuits which occur during the transformation. The power supplied is usually direct current obtained from a battery or other source.

21. Dip In Plate Current, Loaded Dip

A vacuum tube oscillator is operating under the most efficient conditions when the circuits are adjusted (by varying the condenser generally) so that the current as indicated by an ammeter connected in series with the direct current supplied to the plate of the tube has a minimum reading. When the tuning device is varied, the current dips to a minimum reading at which the oscillator should be operated. When power is being drawn from an oscillator and applied, for instance, to an antenna, the dip is not as pronounced and may be at a slightly different setting of the tuning device. The oscillator should always be operated at the valley of the "loaded dip."

22. Parallel Rod Tuning

At very high frequencies, such as those employed in the War Emergency Radio Service, the coils and condensers used for tuning can be replaced by two parallel rods having a sliding shorting bar which is varied for tuning purposes. At very high frequencies these rods are only a few feet long and can feasibly be employed for transmitters in fixed locations.

23. Pack-Type Equipment

This is a term applied to very compact transmitting and receiving units which can easily be carried or strapped on the back. This type of equipment is popularly known as the "walkie-talkie."

24. Superregenerative Receiver, Oscillating Detector, Quenching

A simple type of receiver well adapted for use at the War Emergency Radio Service frequencies. The detector in this type of receiver oscillates continuously at the frequency being received. In addition, the oscillation is broken up or "quenched" at a frequency somewhat above the upper notes which can be perceived by the ear. A receiver which functions in this manner is extremely sensitive, but has disadvantages which can be tolerated if certain precautions are taken. Interference to reception is caused when two receivers are operated fairly near to each other, because of the continuous oscillation and consequent radiation. Proper design will eliminate a considerable portion of the interference. This type of receiver also has very poor selectivity. This difficulty may be overcome by spacing the operating channels sufficiently so that adjacent channels are not received simultaneously.

25. Tube Types

Hundreds of different types of tubes, each designed to perform some special function to advantage, are available. Some are no bigger than an acorn, others are tall as a man. Some are specially designed as:

oscillators for very high frequency, others for efficient audio amplification. Some are enclosed in metal, others in glass. The more common types generally seen in broadcast receivers can be used for a variety of purposes in the War Emergency Radio Service. They carry type numbers, such as the 6J5 or the 1H4. The first figure designates the filament voltage. Thus, the 6J5 has a filament which may be operated from a 6 volt storage battery, while the 1H4 requires less voltage and is suitable for dry battery operation. The letter designates the tube type, and the final number indicates the number of elements (grids, plates, and cathodes) in the tube. Some types, like the 6N7, contain two complete tube systems within one envelope.

APPENDIX II

EXCERPTS FROM THE RULES AND REGULATIONS
GOVERNING THE WAR EMERGENCY RADIO SERVICE

As Amended up to
November 6, 1942

PART 15

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RULES AND REGULATIONS GOVERNING ALL RADIO
STATIONS IN THE WAR EMERGENCY RADIO SERVICE

DEFINITIONS

15.1 War emergency radio service. - The term "War Emergency Radio Service" means a temporary radio communication service intended solely for emergency communication in connection with the national defense and security.

15.2 Civilian defense stations. - The Term "Civilian Defense Stations" means a station operated by a municipal government for emergency communication relating directly to the activities of the United States Citizens' Defense Corps¹ or other equivalent officially recognized organization.

APPLICATIONS

15.11 Applications for station license. - Applications for authorizations in the war emergency radio service shall be submitted on the prescribed forms². A blanket application may be submitted for an authorization to cover the operation of all fixed, portable, mobile, and portable-mobile transmitters proposed to be used in a single coordinated communication system.

OPERATING SPECIFICATIONS

15.21 Frequencies. - The following frequency bands are available for assignment to stations operating in the war emergency radio service:

112000 - 116000 kc
224000 - 230000 kc
400000 - 401000 kc

15.22 Types of emission. - All stations in the war emergency radio service are authorized to use the following types of emissions: A-0, A-1, A-2, A-3, or special for frequency modulation.

15.23 Selection of frequency. - Licensees may select operating frequencies within the available bands provided the equipment is capable of meeting the frequency stability requirements specified in Sec. 15.25.

15.24 Non-exclusive use of frequencies. - No licensee of any station in the war emergency radio service shall have the exclusive use of any frequency. In the event mutual interference occurs between stations operating simultaneously, the licensees shall be required to coordinate the operation of the stations so as to minimize interference, and make the most effective use of the frequencies available.

15.25 Frequency stability. -

(a) Transmitting equipment used in the war emergency radio service

L ¹ The United States Citizens' Defense Corps is an organization of enrolled civilian volunteers established within the Office of Civilian Defense to implement the passive defense.

² FCC Form No. 455.

must be capable of maintaining the operating carrier frequency (without readjustments) within the limits set forth in the table:

<u>Operating frequencies within the bands (Kilocycles)</u>	<u>Maximum deviation band width</u>
112000 - 114000	.1 of one per cent
114000 - 116000	.3 of one per cent
224000 - 227000	.1 of one per cent
227000 - 230000	.3 of one per cent
400000 - 401000	.2 of one per cent

(b) Notwithstanding the maximum frequency deviation permitted, all emissions, including those resulting from keying or modulating a transmitter, shall be confined within the frequency band in which the transmitter is authorized to be operated in accordance with the provisions of Sec. 15.25(a).

(c) Spurious radiations shall be reduced or eliminated in accordance with good engineering practice.

15.26 Frequency measurement procedure. - The licensees of stations in the war emergency radio service shall provide for measurement of the transmitter frequencies, shall establish a procedure for checking them regularly and shall maintain adequate records of such measurements. The measurement of the transmitter frequencies shall be made by means independent of the frequency control of the transmitter, and shall be of sufficient accuracy to assure operation within the maximum deviation permitted under Sec. 15.25.

15.27 Changes in equipment. - The licensee of a station in the war emergency radio service may make any changes in the equipment that are deemed necessary or desirable unless specifically prohibited from doing so by the terms of the license, Provided That:

(a) All changes be made with the full knowledge and consent of the radio aide or the communications officer.

(b) Emissions are not radiated outside the authorized frequency band.

(c) The operating frequency does not deviate more than that specified in Sec. 15.25.

(d) Plate power input does not exceed that authorized in Sec. 15.28.

15.28 Power. -

(a) All stations in the war emergency radio service are authorized to use a maximum unmodulated power input of 25 watts to the plate circuit of the final amplifier stage of an oscillator-amplifier transmitter or to the plate circuit of an oscillator transmitter.

(b) No station shall be operated at any time with a power in excess of that necessary to render satisfactory communication service. In no event shall operations be conducted with power in excess of the authorized power or in excess of the maximum obtainable carrier power output of the transmitter consistent with satisfactory technical operation.

15.29 Modulation limits. -

(a) The transmitted carrier of stations in the war emergency radio service using amplitude modulation shall be modulated not more than 100%.

(b) The transmitted carrier of stations in the war emergency radio service using frequency modulation shall be modulated so that the total frequency swing arising from modulation shall not exceed 100 kilocycles.

15.30 Who may operate stations. - All stations in the war emergency radio service shall be operated only by a radio operator holding a valid war emergency radio service operator permit, Provided, however, that when such stations use radiotelephony, the licensee may permit such persons as the radio operator deems essential to the emergency, to transmit by voice, on condition that the duly licensed operator maintains control over the transmission by listening and turning the carrier on and off when required, and signs the station off after the transmission has been completed.

15.31 Logs. - The station licensee shall maintain written records concurrently with the operation of each station with respect to the following:

- (a) Location of station during operation.
- (b) Date and time of operation in local standard (war) time.
- (c) Identity of station worked and type of communications handled.
- (d) Operating frequencies employed.
- (e) Names and official titles of persons transmitting by voice over the station whenever such voice transmission is actually carried on by other than a duly licensed operator³.
- (f) Name of operator on duty.
- (g) Signature and title of person maintaining log record.

Provided, however, that operation in a blackout or during actual air raids, impending air raids or other enemy military action or acts of sabotage, such record of operation shall be reduced to writing at the earliest opportunity and in such detail as may be practicable.

³ This provision does not eliminate the requirement of a licensed operator on duty at the transmitter location who is responsible for the operation thereof.

IDENTIFICATION OF STATIONS

15.41 Identification of transmitters. - The call letters and unit number assigned in the license shall be permanently affixed to the transmitter by the licensee.

15.42 Transmission of call letters. - Stations in the war emergency radio service shall identify themselves by the call letters and unit number assigned to the transmitter at the beginning and end of each complete exchange of communications.

LICENSES

15.51 Control of equipment. - All equipment for which a license is granted must be owned by or in the possession of the licensee at all times. No license will be granted permitting the operation of a specific transmitter by more than one station licensee in the war emergency radio service.

15.52 Cancellation without notice or hearing. - A license authorizing the operation of a station in the war emergency radio service is granted upon the express condition that said grant is subject to change or cancellation by the Commission at any time without advance notice or hearing, if in its discretion such action is deemed necessary for the national security and defense and successful conduct of the war.

15.53 License period. -

- (a) Station licenses normally will be issued for a period of one year unless otherwise stated therein.
- (b) Dates of expiration of licenses shall be in accordance with the following:
 - (1) For stations in the states of Alabama, Arizona, Arkansas, California, Colorado, Connecticut, District of Columbia, Delaware, and Florida, - the first day of February of each year.
 - (2) For stations in the states of Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, and Kentucky, - the first day of March.
 - (3) For stations in the states of Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, and Montana, - the first day of April.
 - (4) For stations in the states of Nebraska, Nevada, New Hampshire, New Mexico, New York, North Carolina, and North Dakota, - the first day of May.
 - (5) For stations in the states of Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, and South Dakota, - the first day of June.

(6) For stations in the states of Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming, and for stations in the territories and possessions, - the first day of July.

(c) Unless otherwise directed by the Commission, each application renewal of station license shall be filed on the proper form⁴ at least sixty (60) days prior to the expiration date of the license sought to be renewed.

15.54 Availability of station license. - The original license shall be associated with the station normally in control of all stations covered by the license, and photocopies of the original license provided by the licensee shall be associated with each of the other stations covered by the license. The original and all photocopies shall be readily available for inspection at any time by an authorized government representative.

CIVILIAN DEFENSE STATIONS

15.61 Eligibility for station license. - Authorizations for civilian defense stations will be issued only to municipal governments such as cities, towns, counties, etc.

15.62 Supplementary statements. - The applicant shall submit with the application complete and detailed information on the following:

(a) The proposed plan of operation including:

1. General operating procedure.
2. The scope of service to be rendered.
3. Type of messages to be transmitted.
4. Methods to be used in monitoring, supervising, and controlling the operation of all stations for which license is requested, including method of compliance with Restricted Order #2.
5. Methods used to measure the operating frequencies of the transmitters.
6. Provisions for periodic inspection of the equipment.
7. Source and distribution of the equipment.

(b) The area in which the stations are to be operated:

If service is to be rendered to adjacent municipalities, the applicant must submit sworn copies of agreements made between the applicant and the adjacent municipalities. Such agreements shall show that the applicant is required to furnish service and the adjacent municipalities agree to accept such service and not to request individual authority, and that such agreements shall provide notification to the Commission sixty (60) days prior to termination thereof.

- (c) Methods used to ascertain the loyalty and integrity of radio station operating personnel.
- (d) Plans for enlisting radio operating personnel, and whether they will serve on a paid or voluntary basis.

Scope of Service

15.63 Service which may be rendered. - Civilian defense stations may be used for essential communication relating to civilian defense and only during or immediately following actual air raids, impending air raids, or other enemy military operations or acts of sabotage.

15.64 Communication with other stations. - Within the scope of service permitted under Sec. 15.63 and during tests and drills, civilian defense stations may be used to communicate with other stations in the war emergency radio service, and with stations in the emergency radio service (police, forestry, special emergency, and fire stations) and with United States Government stations in those cases which require cooperation or coordination of activities. Transmissions not directed to a specific authorized station are prohibited.

Supervision and Control

15.66 Operational supervision. - The operation of civilian defense stations shall be directed at all times by a duly qualified radio aide provided, however, that the delegation of such supervision shall in no way relieve the licensee of the ultimate responsibility for the proper operation of the stations in accordance with the terms of the station license.

RADIO AIDE

15.71 Definition. - The term "Radio Aide" means the official designated by the station licensee to direct and supervise the operation of all of the radio stations to be covered in the license for which application is made.

15.72 Qualifications. - The radio aide shall

- (a) Hold a valid operator's license of any class granted by the Commission except a restricted radio telephone operator's permit; and shall
- (b) Have been investigated and certified by the station licensee as to his loyalty to the United States and recognized integrity.

15.73 Certification. - The station licensee shall submit to the Commission, on a prescribed form, the name and address of the initial radio aide and his successor (s), together with a statement from the radio aide that he has accepted such appointment, and the station licensee shall certify:

- (a) That the radio aide has been duly investigated by the licensee and is believed to be loyal to the United States and is of recognized integrity; and

- (b) That his technical and administrative qualifications are adequate for the proper performance of his duties.

15.74 Duties. - The duties of the radio aide shall include among others:

- (a) The direction and supervision of all radio stations to be covered in the license to assure strict compliance with the terms of the station license.
- (b) The provision for the adequate monitoring of all transmissions of the stations under his supervision to assure compliance with the rules and regulations of the Commission, and to guard against the improper use of the radio stations and intentional or inadvertent transmission which might be of value to the enemy.
- (c) Inspection of the equipment periodically to insure satisfactory technical operation.
- (d) Certification of the names of proposed radio operators after a thorough investigation has been made relative to their loyalty to the United States and their known integrity.

Tests and Drills

15.75 Tests. - The licensees of civilian defense stations are permitted to make such tests as are necessary for the purpose of maintaining equipment, making adjustments to insure that the apparatus is in operating condition, training personnel, and perfecting methods of operating procedure, Provided That such tests shall be conducted only during the following periods:

- (a) Tests may be conducted by individual stations during the three months' period immediately following the date on which the respective station license was first granted, in accordance with the following schedule:

Time Zone	Eastern	Central	Mountain	Pacific
Wednesdays	10 pm - 12 mid.	9 pm - 11 pm	8 pm - 10 pm	7 pm - 9 pm
Sundays	5 pm - 7 pm	4 pm - 6 pm	3 pm - 5 pm	2 pm - 4 pm

- (b) Tests may be conducted by individual stations during any period of the respective station license, in accordance with the following schedule:

Time Zone	Eastern	Central	Mountain	Pacific
Sundays	5 pm - 7 pm	4 pm - 6 pm	3 pm - 5 pm	2 pm - 4 pm

All times given are local standard (war) time.

15.76 Drills. - Licensees of civilian defense stations may conduct drills during practice alerts, practice blackouts, practice mobilizations or other comparable situations as may be initiated and ordered by the proper military authority or local civil defense authority, provided that a notice, by mail,

of such operations is sent within twenty-four hours after the drill to the Inspector in Charge of the radio district in which the stations are located, and a copy to the Federal Communications Commission in Washington, D.C.

RULES AND REGULATIONS GOVERNING ALL OPERATORS
OF STATIONS IN THE WAR EMERGENCY RADIO SERVICE

15.101 Licensed operators required. - The actual operation of any station in the war emergency radio service shall be carried on only by a duly qualified radio operator holding a war emergency radio service operator permit (See Sec. 15.30). The permit shall be in the possession of the operator at all times while on duty, and shall be produced for inspection when requested by an authorized representative of the government or the station licensee.

15.102 Eligibility. - To be eligible for a war emergency radio service operator permit an applicant shall:

- (a) Hold a radio operator license or permit of any class issued by the Commission.
- (b) Have complied with the provisions of Commission Order No. 75 (fingerprints, proof of citizenship, etc.)
- (c) Be approved by the station licensee and be properly certified for participation in the activities of the organization.

15.103 Application requirements. - An application for each war emergency radio service operator permit shall be submitted on the prescribed form⁶ through the station licensee. This application shall include the name and address of the station licensee together with the name and address of the proposed radio operator, and the class of operator license held by the applicant, and shall be certified to by the radio aide or communications officer that:

- (a) The proposed operator has been duly investigated and is believed to be loyal to the United States, and is of recognized integrity.
- (b) His technical qualifications are adequate for the proper performance of his duties.

15.104 Validity of permit.

- (a) The war emergency radio service operator permit authorizes only the operation of the stations licensed to a particular licensee, and is valid for the duration of the war and six months thereafter, but in no event to exceed a period of five years from date of issuance.

⁶ FCC Form No. 457.

- (b) The war emergency radio service operator permit is valid only when the photograph and signature of the holder have been affixed thereto.
- (c) A photocopy of such permit will not be recognized for the operation of any station in the war emergency radio service.

15.105 Cancellation of permit. -

- (a) A war emergency radio service operator permit is granted upon the express condition that said permit is subject to change or cancellation by the Commission at any time without advance notice or hearing, if in its discretion such action is deemed necessary for the national security and defense and the successful conduct of the war.
- (b) The holder of war emergency radio service operator permit shall surrender such permit to the Commission for cancellation at the request of a station licensee or upon termination of the operator's connection with the station licensee with whom he was previously affiliated.

15.106 Duplicate permit. - An operator whose permit has been lost, mutilated or destroyed shall immediately notify the Commission. Any operator permittee applying for a duplicate permit to replace an original which has been lost, mutilated or destroyed shall submit to the station licensee for transmittal to the Commission such mutilated license or affidavit attesting to the facts regarding the manner in which the original was lost or destroyed. If the original is later found, it or the duplicate permit shall be returned to the Commission for cancellation.

15.107 Renewal of war emergency radio service operator permit. - A war emergency radio service operator permit may be renewed upon proper application which should be submitted to the Commission through the station licensee as in the case for an original permit.

15.108 Suspension of operator licenses. - The war emergency radio service operator permit may be cancelled and any other class of license held by the operator may be suspended for the violation by the operator of any provision of law, treaty, rules or regulations of the Commission.

APPENDIX III

The following list of the radio districts gives the address of each field office of the Federal Communications Commission and the territory embraced in each district:

Radio district	Address of the Inspector in Charge	Territory within District	
		States, etc.	Counties
1	Customhouse, Boston, Mass.	Connecticut	All counties
		Maine	do
		Massachusetts	do
		New Hampshire	do
		Rhode Island	do
		Vermont	do
2	Federal Building, New York, N. Y.	New Jersey	Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union and Warren.
		New York	Albany, Bronx, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Schenectady, Suffolk, Sullivan, Ulster and Westchester.
3	New United States Customhouse, Philadelphia, Pa.	Delaware	Newcastle.
		New Jersey	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean, and Salem.
		Pennsylvania	Adams, Berks, Bucks, Carbon, Chester, Cumberland, Dauphin, Delaware, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Perry, Philadelphia, Schuylkill and York.
4	508 Old Town Bank Building, Gay Street and Fallsway, Baltimore, Maryland	Delaware	Kent and Sussex.
		District of Columbia	All counties.
		Maryland	do
		Virginia	Arlington, Clark, Fairfax, Fauquier, Frederick, Loudoun, Page, Prince William, Rapahannock, Shenandoah, and Warren.

Radio dis- trict	Address of the Inspector In Charge	Territory within District	
		States, etc	Counties
5	New Post Office Building, Norfolk, Virginia	North Carolina Virginia	All except district 6. All except district 4.
6	411 Federal Annex, Atlanta, Georgia (Sub-office: Post Office Bldg., Savannah, Ga.)	Alabama Georgia North Carolina South Carolina Tennessee	All except district 8. All counties. Ashe, Avery, Buncombe, Burke, Caldwell, Chero- kee, Clay, Cleveland, Graham, Haywood, Hen- derson, Jackson, McDowell, Macon, Madison, Mitchell, Polk, Rutherford, Swain, Transylvania, Watauga, and Yancey. All counties. do
7	Federal Building, Miami, Florida. (Sub-office: Post Office Bldg. Tampa, Florida.)	Florida	All except district 8.
8	Customhouse, New Orleans, Louisiana	Alabama Arkansas Florida Louisiana Mississippi Texas	Mobile, Baldwin. All counties. Escambia. All counties. do City of Texarkana only.
9	Federal Building, Galveston, Texas	Texas	Arkansas, Brazoria, Brooks, Calhoun, Cameron, Chambers, Fort Bend, Galveston, Goliad, Harris, Hidalgo, Jackson, Jef- ferson, Jim Wells, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Victoria, Wharton and Willacy.
10	U. S. Terminal Annex Building, Dallas, Texas.	New Mexico Oklahoma Texas	All counties. do All except district 9 and the city of Tex- arkana.

Radio dis- trict	Address of the Inspector In Charge	Territory within District	
		States, etc.	Counties
11	U. S. Post Office and Courthouse, Los Angeles, California. (Sub-office: U. S. Customhouse and Courthouse, San Diego, California.)	Arizona California Nevada	All counties. Imperial, Inyo, Kern, Los Angeles, Orange, Riverside, San Ber- nardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Clark
12	Customhouse, San Francisco, California.	California Nevada Guam Midway Wake American Samoa	All except District 11 All except Clark.
13	805 Terminal Sales Building, Portland, Oregon	Idaho Oregon	All except district 14 All counties
14	Federal Office Building, Seattle, Washington. (Sub-office: Shattuck Building, Juneau, Alaska.)	Alaska Idaho Montana Washington	Benewah, Bonner, Bound- ary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Beaverhead, Broadwater, Cascade, Deerlodge, Flathead, Gallatin, Glacier, Granite, Jef- ferson, Lake, Lewis and Clark, Lincoln, Madison, Meagher, Mineral, Mis- soula, Pondera, Powell, Ravalli, Sanders, Silver Bow, Teton and Toole. All counties.
15	Customhouse, Denver, Colorado	Colorado Montana Utah Wyoming	do All except district 14. All counties. do
16	Uptown Post Office and Federal Courts Building, St. Paul, Minnesota	Minnesota Michigan North Dakota South Dakota Wisconsin	All counties. Alger, Baraga, Chip- pewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, and Schoolcraft. All counties. do All except District 18.

Radio dis- trict	:	Address of the Inspector	:	Territory within District	
				States, etc.	Counties
17	:	U. S. Courthouse, Kansas	:	Iowa	: All except district 18
	:	City, Missouri	:	Kansas	: All counties.
	:		:	Missouri	: do
	:		:	Nebraska	: do
18	:	U. S. Courthouse,	:	Illinois	: do
	:	Chicago, Illinois	:	Indiana	: do
	:		:	Iowa	: Allamakee, Buchanan,
	:		:		: Cedar, Clayton, Clin-
	:		:		: ton, Delaware, Des
	:		:		: Moines, Dubuque, Fay-
	:		:		: ette, Henry, Jackson,
	:		:		: Johnson, Jones, Lee,
	:		:		: Linn, Louisa, Musca-
	:		:		: time, Scott, Washing-
	:		:		: ton, and Winneshick.
	:		:	Wisconsin	: Columbia, Crawford,
	:		:		: Dane, Dodge, Grant,
	:		:		: Green, Iowa, Jeffer-
	:		:		: son, Kenosha, Lafay-
	:		:		: ette, Milwaukee,
	:		:		: Ozaukee, Racine, Rich-
	:		:		: land, Rock, Sauk,
	:		:		: Walworth, Washington,
	:		:		: and Waukesha.
19	:	New Federal Building,	:	Kentucky	: All counties.
	:	Detroit, Michigan	:	Michigan	: All except district 16
	:	(Sub-office: Old Post	:	Ohio	: All counties.
	:	Office Bldg., Cleveland,	:	West Virginia	: do
	:	Ohio.)	:		
20	:	Federal Building, Buffalo,	:	New York	: All except district 2.
	:	New York	:	Pennsylvania	: All except district 3.
21	:	609 Stangenwald Building,	:	Territory of	:
	:	Honolulu, Territory of Hawaii.	:	Hawaii.	:
22	:	P.O. Box 2987 - (322 Federal	:	Puerto Rico	:
	:	Building), San Juan, Puerto	:	Virgin Islands:	:
	:	Rico	:		: